DESCRIPTION

BLOCK FOR CONSTRUCTION, PANEL FOR CONSTRUCTION USING THE BLOCK, AND METHOD OF FORMING PANEL FOR CONSTRUCTION

TECHNICAL FIELD

[0001]

The present invention relates to a technique for constructing a flat structure such as a wall, a floor and a ceiling of a reinforced concrete building.

BACKGROUND ART

[0002]

When constructing a structure such as a wall, a floor and a ceiling of a reinforced concrete building, a construction method which has been employed heretofore is that a concrete mold is assembled at a construction site, and reinforcing bars are arranged in the mold, followed by casting of concrete.

[0003]

In the above on-site casting method, however, it takes considerable labor and time to assemble a concrete mold, to cast concrete, and to harden and cure the concrete, which hinders effort to shorten work periods. Furthermore, these steps require highly-skilled expert engineers in each field.

[0004]

In addition, a broad work space is needed for carrying in a mold and reinforcing bars to a site as well as for assembling members and casting concrete. Therefore, if a road leading to a construction site is narrow or a site is small, workability is extremely lowered.

[0005]

In view of the above problems, some other techniques for constructing a structure such as a wall, a fence and a basic foundation have been developed. Specifically, various kinds of concrete blocks that have been fabricated in a plant beforehand are carried onto a construction site, these concrete blocks are arranged in vertical and horizontal directions to form a flat body, and the blocks are fixed to each other with a given connecting means, thereby constructing a wall or a fence (see the patent documents 1 and 2, for example).

[0006]

In the stacking-type concrete block described in the patent document 1, connecting pin members are inserted into a plurality of pipe members implanted in top and bottom surfaces of the blocks to connect the blocks to each other, thereby constructing a wall, a basic foundation, or the like.

[0007]

In the method of constructing a block wall described in the patent document 2, a number of concrete blocks are laid out in vertical and horizontal directions, joint surfaces of each of the concrete blocks are bonded with an adhesive agent while inserting steel bars for loading tensile force into predetermined positions to fasten the blocks. A block panel thus formed is built up as a wall.

[0008]

Patent Document 1: Unexamined Japanese Utility Model Registration Publication No. Sho 64-7618 (pages 5 to 9)

Patent Document 2: Unexamined Japanese Patent Publication No. Sho 55-39569 (pages 3 to 8)

DISCLOSURE OF THE INVENTION

[0009]

In the stacked-type concrete block described in the patent document 1, the use of the connecting pin members enables the blocks to be accurately and securely stacked. However, as the connecting pin members have to be provided on every boundary portion between the blocks abutting in a vertical direction, the work requires a large amount of time and labor.

[0010]

Moreover, since the connecting pin members do not pull the blocks to fix them to each other, if pulling force is loaded in axial directions of the connecting pin members at the boundary portions between the stacked and constructed blocks, the blocks may separate. As a result, whereas this block is preferable to the structures on which only compressive force in the axial directions of the connecting pin members is loaded, such as a wall, a fence and a basic foundation, it is not suitable for the structure such as a floor of a building where external force can be loaded in a direction of deflection.

[0011]

On the other hand, the method of constructing a block wall described in the patent document 2, joint surfaces of a number of blocks laid out in vertical and horizontal directions are bonded with an adhesive agent while inserting steel bars for loading tensile force to fasten the blocks, thereby forming a block panel. In this case, the force of connecting blocks to each other is small because the places into which the steel bars for loading tensile force are inserted are joint portions of adjacent blocks.

[0012]

Furthermore, as the joint surfaces of these blocks are bonded with an adhesive agent, the blocks has poor durability because the jointed portions of the blocks sometimes break up or cause a gap therebetween due to deterioration or shrinkage of the adhesive agent with passage of time after construction.

[0013]

A problem to be solved by the present invention is to provide a technique for constructing a flat structure such as a wall or a floor of a building in a relatively short time and an easy manner while improving durability of the flat structure.

[0014]

A block for construction according to the present invention is a block for construction capable of constructing a flat structure by arranging the plurality of blocks in a flat state with outer peripheral surfaces thereof brought into contact with each other, the block for construction comprising a plurality of through holes formed for inserting linear or bar-like stretching members, and recessed parts formed on outer peripheral surfaces crossing an axial direction of the through holes to dispose, in a direction three-dimensionally crossing an axial direction of the stretching members, other stretching members.

[0015]

In the above structure, the plurality of the blocks for construction are arranged in a flat state so as to have contact with each other on their outer peripheral surfaces in such a manner that the plurality of the through holes communicate with each other while inserting the stretching members into the plurality of the through holes and disposing the stretching members on the recessed parts. By generating tensile force on these stretching members, the blocks for construction are bonded by pressure to form a flat structure.

[0016]

Accordingly, by building up the above flat structure as a wall, a floor or a ceiling when constructing a building, the flat structure such as the wall or the floor can easily be constructed in a relatively short time. In addition, the adjacent blocks for construction are bonded with pressure by only using the stretching members , which causes no deterioration

of an adhesive agent, leading to excellent durability.

[0017]

Here, the plurality of through holes may preferably be provided in parallel with each other with intervals therebetween in a through-thickness direction of a body of the block or in a direction perpendicular thereto. With this arrangement, the body of the block can be firmly held with the stretching members inserted into these through holes, and thus the strength after construction of the flat structure is further increased.

[0018]

As another arrangement, if a plurality of cavities opening at more than one place on the outer peripheral surfaces is provided, the weight of the body of the block itself can be decreased, and heat insulation is also improved. Moreover, after arranging the bodies of the plurality of blocks for construction to form the flat structure, the cavities can communicate with each other in a direction along the surfaces, thereby decreasing the weight of the flat structure and improving the heat insulation thereof.

[0019]

Next, a panel for construction according to the present invention is a panel for construction formed by arranging the plurality of the above-described blocks for construction in a flat state with outer peripheral surfaces thereof brought into contact with each other with the plurality of through holes being communicated, inserting the stretching members into the plurality of through holes while disposing the stretching members on the recessed parts, and bonding the blocks for construction by pressure by generating tensile force on these stretching members.

[0020]

By the above structure, a flat structure such as a wall or a floor of a building can be easily constructed in a relatively short time. No adhesive agent is used at all, and thus the

durability of the flat structure is also improved.

[0021]

Preferably, reaction force members for generating tensile force on the above-described stretching member may be attached to outer peripheral surfaces of the blocks for construction, which are located on peripheral portions of the panel for construction. The reaction force members thus attached can appropriately generate tensile force on the stretching members, which further enhances the strength and durability. In this case, if the reaction force members are attached so as to cover whole peripheral portions like a frame, the rigidity is increased while the reaction force of the tensile force generated on the stretching members can be dispersed over the whole peripheral portions. Consequently, generation of cracks caused by stress concentration can be prevented.

[0022]

In this case, preferably, a gap filling agent may intervene between the adjacent blocks for construction for dispersing reaction force. By this structure, in the panel for construction, small gaps occurring from poor precision manufacturing of the blocks existing between the adjacent blocks for construction are filled with the gap filling agent. Thus, compressive stress generated between the blocks for construction due to the pressure exerted on the blocks for construction by the tensile force of the stretching members is uniformly dispersed by the gap filling agent existing between the adjacent blocks for construction and transmitted all over the adjacent blocks for construction. Therefore, generation of cracks or ruptures on the blocks for construction due to concentration of the compressive stress can be prevented.

[0023]

In this case, the above-described gap filling agent to be employed may be a curable paste or a material deformable by the pressure of the bonded blocks for construction. Here,

the curable paste refers to a substance which is a paste at the start of use and, after evaporation of water or a solvent, or through chemical reaction such as hardening reaction, has a property of hardening to the extent not to rupture by the pressure of the bonded blocks for construction. The material deformable by the pressure of the bonded blocks means that at least a part of the material is deformable so as to fill the gap between the blocks along the shape of the gap when the material is clamped between the blocks for construction.

[0024]

The gap filling agents having the above-described properties seep or cause deformation between the adjacent blocks for construction by the pressure exerted on the blocks for construction by the tensile force of the stretching members, and fill the gap existing between the blocks for construction. Thus, most of the small gaps between the blocks for construction can be eliminated. Accordingly, the compressive stress generated between the blocks for construction is uniformly dispersed and transmitted through the gap filling agent, thereby preventing generation of cracks or ruptures due to stress concentration. The above filling agents intervene between the adjacent blocks for construction when arranging the plurality of blocks in a flat state. In the case of curable paste, preferably, when the paste is hardened to the state in which the paste itself can transmit the compressive stress, the blocks for construction are pressurized and bonded to fill the gaps between the blocks for construction. As the material deformable by the pressure of the bonded blocks, a paper material (cardboard, for example), a metallic material (a steel sheet, for example) or the like can be employed.

[0025]

If a cement paste or liquid glass is used as the curable paste, small gaps existing between the adjacent blocks for construction can be filled in without any unevenness and leaks, which leads to an excellent stress dispersing function. Similar to the above, it is

preferable that the blocks for construction are bonded with pressure at the point that the cement paste or the liquid glass is hardened to the state in which it can transmit the compressive stress.

[0026]

Meanwhile, as the reaction force member described above, preferably, a block body having a solid structure may be used in a region close to the peripheral portion of the panel for construction. Here, the solid structure refers to a structure having neither a through hole nor a cavity except an opening for inserting a bolt. By this structure, it is possible to prevent the reaction force member from rupture or damage due to pulling force loaded on the reaction force member (the block body) for generating tensile force on the stretching members.

[0027]

Next, a method of forming a panel for structure according to the present invention is a method comprising steps of arranging the plurality of above-described blocks for construction to be adjacent to each other in a flat state with a gap filling agent for dispersing stress intervening between outer peripheral surfaces of the blocks for construction and with the plurality of above-described through holes communicating with each other, inserting stretching members into the plurality of through holes while disposing stretching members on the above-described recessed parts, and loading tensile force on the stretching members to bond the blocks for construction with pressure.

[0028]

By the above structure, a panel for construction suitable for a flat structure such as a wall or floor of a building can be easily formed in a relatively short time. Furthermore, the intervention of the gap filling agent eliminates generation of cracks or rupture due to stress concentration, thereby further improving the strength and the durability.

[0029]

(1) In a block for construction capable of constructing a flat structure by arranging a plurality of the blocks with their outer peripheral surfaces brought into contact with each other, provided are a plurality of through holes formed for inserting linear or bar-like stretching members and recessed parts formed on outer peripheral surfaces crossing the axial direction of the through holes to dispose, in a direction three-dimensionally crossing the stretching members, other stretching members. Therefore, by simply arranging these blocks for structure in a flat state and connecting them, a flat structure such as a wall or a floor of a building can be constructed in a relatively short time and an easy manner while enhancing the durability of the flat structure.

[0030]

(2) A plurality of through holes is provided in parallel with each other with intervals therebetween in a through-thickness direction of a body of the block or a direction vertical thereto. As this enables the block body to be firmly held with the stretching members inserted into these through holes, the strength after construction of the flat structure is further increased.

[0031]

(3) Cavities opening at more than one place provided on the above-described outer peripheral surfaces can decrease the weight of the block body itself and render heat insulation. In addition, when arranging the plurality of blocks for structure to form a flat structure, these cavities can communicate with each other in a direction along the surfaces so that the weight of the flat structure can be decreased while improving the heat insulation thereof.

[0032]

(4) A panel for construction is formed by arranging the blocks for construction as described in the above (1) to (3) in a flat state with outer peripheral surfaces thereof brought into contact with each other and with the plurality of through holes being communicated, inserting the stretching members into the plurality of through holes while disposing the stretching members on the recessed parts, and bonding the blocks for construction by pressure by generating tensile force on these stretching members. By this structure, a flat structure such as a wall or a floor of a building can be easily constructed in a relatively short time. No adhesive agent is used at all, and thus the durability of the flat structure is also improved.

[0033]

(5) By attaching reaction force members for generating tensile force on the above stretching members to outer peripheral surfaces of the blocks for construction, which are located on peripheral portions, the strength and the durability can be further improved.

[0034]

(6) With a gap filling agent intervening between the adjacent blocks of construction for dispersing reacting force, gaps between the adjacent blocks for construction are filled with the gap filling agent, and the compressive stress generated between the blocks for construction is uniformly dispersed and transmitted over the adjacent blocks for construction. Therefore, generation of cracks or ruptures on the blocks for construction due to concentration of the compressive stress can be prevented.

[0035]

(7) As the above gap filling agent, if a curable paste, or a metallic or paper material which is deformable by the pressure of the bonded blocks for construction is employed, most of the small gaps between the blocks for construction can be eliminated, thereby preventing generation of cracks or ruptures due to stress concentration.

[0036]

(8) By using a cement paste or liquid glass as the curable paste, small gaps existing between the blocks for construction can be filled in a relatively easy operation without causing any unevenness. Accordingly, generation of cracks or ruptures due to stress concentration can be eliminated.

[0037]

(9) As the reaction force member described above, if a block body having a solid structure is used in a region close to the peripheral portion of the panel for construction, it is possible to prevent the reaction force member from rupture or damage due to pulling force loaded on the reaction force member for generating tensile force on the stretching members.

[0038]

(10) The method of the present invention includes steps of arranging the plurality of blocks for construction described above (1) to (3) in a flat state to be adjacent to each other with a gap filling agent for dispersing stress intervening between outer peripheral surfaces of the blocks for construction and with the plurality of above-described through holes communicating with each other, inserting stretching members into the plurality of the through holes while disposing stretching members on the above-described recessed parts, and loading tensile force on the stretching members to bond the blocks for construction by pressure. By this method, it is possible to form a panel for construction with high strength and durability suitable for a flat structure such as a wall or a floor of a building easily in a relatively short time.

[0039]

Fig. 1 is a perspective view illustrating a block for construction of a first embodiment of the present invention.

Fig. 2 (a) is a plan view of the block for construction in Fig. 1; (b) is a front view of the same block; and (c) is a side view of the same block.

Fig. 3 is a perspective view illustrating a block for construction of a second embodiment of the present invention.

Fig. 4 (a) is a plan view of the block for construction in Fig. 3; (b) is a front view of the same block; and (c) is a side view of the same block.

Fig. 5(a) is a perspective view of a panel for construction formed with the block for construction in Fig. 1; and (b) is a perspective view illustrating an arrangement of stretching members in the panel for construction.

Fig. 6 is an exploded perspective view illustrating a corner portion of the panel for construction in Fig. 5 (a).

Fig. 7 is a schematic view illustrating a state where tensile force is loaded on the stretching members of the panel for construction in Fig. 5.

Fig. 8 (a) is a perspective view illustrating a panel for construction formed with the block for construction in Figs. 1 and 2; and (b) is a perspective view illustrating an arrangement of stretching members in this penal for construction.

Fig. 9 is a partially omitted perspective view illustrating a state where a wall and a floor of a building are constructed by the panel for construction in Fig. 5 (a) and Fig. 8 (a).

Fig. 10 is a perspective view illustrating a fence constructed by combining panels for construction formed with the block for construction in Fig. 1.

Fig. 11 is a plan view illustrating a block for construction of a third embodiment of the present invention.

Fig. 12 is a side view of the block for construction in Fig. 11.

Fig. 13 is a plan view illustrating a block for construction of a fourth embodiment of the present invention.

Fig. 14 is a side view of the block for construction in Fig. 13.

Fig. 15 is a plan view of an auxiliary block which is used in combination with the block for construction in Figs. 11 and 13.

Fig. 16 is a side view of the auxiliary block in Fig. 15.

Fig. 17 is a perspective view illustrating a panel for construction formed with the block for construction in Figs. 11 and 13.

Fig. 18 is a partially cutaway perspective view of the panel for construction in Fig. 17.

Fig. 19 (a) is a partially enlarged perspective view of the panel for construction in Fig. 17; and (b) is a partially enlarged view of (a).

Fig. 20 (a) is a sectional view taken along the line A-A of Fig. 17; and (b) is a sectional view taken along the line B-B of Fig. 17.

[0041]

In reference to Figs. 1 to 10, explained below are a block for construction and a panel for construction according to first and second embodiments of the present invention.

[0042]

As shown in Figs. 1 and 2, a block for construction 10 of the first embodiment of the present invention is, as further described below, a block capable of constructing a flat structure by arranging the plurality of blocks in a flat state with four outer peripheral surfaces thereof, that are, an upper surface 10a, a lower surface 10b, a left side surface 10c and a right side surface 10d brought into contact with each other. In the block for construction 10, a plurality of through holes 11 for inserting bar-like stretching members therein, as further described below, are formed in parallel with a front surface 10f and a rear surface 11e, and recessed parts 12 are formed on the upper surface 10a and the lower surface 10b forming outer peripheral surfaces crossing an axial direction of the through

holes 11 to dispose, in a direction three-dimensionally crossing the stretching members inserted into the through holes 11, other stretching members.

[0043]

The block for construction 10 is further formed with five cavities 13 opening on the upper surface 10a and the lower surface 10b in a manner of penetrating the block for construction 10. On each of the left side surface 10c and the right side surface 10d, a groove 14 is formed in the same direction of the arranging direction of the cavities 13.

[0044]

A block for construction 20 illustrated in Figs. 3 and 4 is, similar to the block for construction 10, a block capable of constructing a flat structure by arranging the plurality of blocks in a flat state with four outer peripheral surfaces thereof, that are, an upper surface 20a, a lower surface 20b, a left side surface 20c and a right side surface 20d brought into contact with each other. In the block for construction 20, a plurality of through holes 21 for inserting stretching members therein are formed in parallel with a front surface 20f and a rear surface 20e, and recessed parts 22 are formed on the upper surface 20a and the lower surface 20b forming outer peripheral surfaces crossing an axial direction of the through holes 21 to dispose, in a direction three-dimensionally crossing the stretching members inserted into the through holes 21, other stretching members.

[0045]

The block for construction 20 is also formed with two cavities 23 opening on the upper surface 20a and the lower surface 20b in a manner of penetrating the block for construction 20. On each of the left side surface 20c and the right side surface 20d, a groove 24 is formed in the same direction of the arranging direction of the cavities 23.

[0046]

As described above, the only difference between the block for construction 10 and

the block for construction 20 is the dimension in a length direction. The dimensions and structures of the remaining parts are the same. In other words, only a dimension in a length direction 10w of the block for construction 10 is a double of a dimension in a length direction 20w of the block for construction 20, and other features are the same.

[0047]

As shown in Fig. 5 (a), the plurality of blocks for construction 10 are arranged in a flat state so that the outer peripheral surfaces thereof are brought into contact with each other and that the plurality of through holes 11 linearly communicates with each other in the axial direction. As shown in Fig. 5 (b), stretching members 30 are inserted into the plurality of through holes 11 communicating with each other, and stretching members 31 are disposed on the recessed parts 12. Then, reaction force members 32 are attached along the outer peripheral surfaces of the blocks for construction 10 located on an utmost outer periphery. As shown in Fig. 6, holding plates 34a, 34b and 34c are mounted on external thread parts 30a and 31a of the stretching members 30 and 31 that are protruding from through holes 33 of the reaction force members 32, spring washers 36 are attached, and nuts 35 are screwed thereon.

[0048]

Then, by fastening the nuts 35 to generate tensile force on the stretching members 30 and 31, the blocks for construction 10 are firmly bonded together and, as shown in Fig. 5, a panel for construction 40 which is a flat structure is formed. In this case, at the portions where the reaction force members 32 abut on each other, it is preferable to use the holding plates 34a and 34c that are long enough to stride over the adjacent portions so that the adjacent reaction force members can be firmly connected to each other.

[0049]

As the stretching members 30 and 31, if deformed reinforcing bars provided with

external threads on outer peripheries thereof are employed, the nuts 35 can be screwed on without forming the external threads parts 30a and 31a. In addition, if the stretching members 30 and 31 are coated with a corrosion-resistant material such as a resin pipe, the corrosion resistance is enhanced to prevent rust development due to moisture infiltrating from boundaries between the blocks for construction 10. Furthermore, the spring washers 36 intervening between the holding plates 34a, 34b and 34c and the nuts 35 can prevent deterioration of the tensile force caused by contraction of the block for construction 10 or extension of the stretching members 30 and 31.

[0050]

In a panel for construction 40, the stretching members 30 and the stretching members 31 are disposed in a manner perpendicularly crossing each other lengthwise and crosswise. While the stretching members 31 are disposed one by one in each of the spaces formed by the adjacent recessed parts 12, the stretching members 30 are disposed two by two to be arranged in a through-thickness direction of the panel. Thus, the numbers of the stretching members disposed are different lengthwise and crosswise. Accordingly, when fastening the nuts 35 to load tensile force on the stretching members 30 and 31, the tensile force is differentiated so as to equalize the strength in a direction of deflection of the panel for construction 40.

[0051]

Specifically, as shown in Fig. 7 (a), when 10 tons of tensile force is loaded on the stretching members 31 in the direction of arrows, it is preferable that, in two stretching members 30X and 30Y shown in Fig. 7 (b), 10 tons of tensile force is loaded in the direction of arrows on the stretching member 30X located on an upper side, while 5 tons of tensile force is loaded in the direction of arrows on the stretching member 30Y located on a lower side. By loading tensile force in this manner, the difference between the strength of the

panel for construction 40 in the direction of the stretching members 31 and the strength in the direction of the stretching members 30X and 30Y can be considerably decreased, thereby equalizing the strength of the panel for construction 40 in the direction of deflection.

[0052]

In the panel for construction 40, the blocks for construction 10 are arranged in a grid pattern. However, as shown in Fig. 8, it is possible to arrange the plurality of blocks for construction 10 in a zigzag pattern to form a panel for construction 50. In this case, the blocks for construction 20 shown in Fig. 3 are arranged in peripheral portions so as to form an utmost periphery straight. The stretching members 30 and 31 and the reaction force members 32 are mounted in a similar manner to the panel for construction 40.

[0053]

When constructing a building, as shown in Fig. 9, the panels for construction 40 and 50 formed as above are built up as a wall W, a floor F and a ceiling C, thereby easily constructing these flat structures in a relatively short time. In this case, by providing beams 60 and 61 on a connecting portion between the wall W and the floor F and on a connecting portion between the wall W and the ceiling C to receive the peripheral portions of the panels for construction 40, these connecting portions can be easily constructed while enhancing the strength.

[0054]

In the panels for construction 40 and 50, the blocks for construction 10 and 20 are bonded only by the stretching members 30 and 31 without using any adhesive agent. Therefore, no deterioration of an adhesive agent is caused after construction, leading to excellent durability.

[0055]

As shown in Figs. 1 to 4, the plurality of through holes 11 and 21 in the blocks for

construction 10 and 20 are provided in parallel with each other with intervals therebetween in though-thickness directions 10t and 20t of the blocks 10 and 20 or on the dimensions in a length direction 10w and 20w which are perpendicular to the through-thickness directions 10t and 20t. Accordingly, the stretching members 30 inserted into these through holes 11 and 21 can securely hold the blocks 10 and 20 to construct the panels for construction 40 and 50 with high strength.

[0056]

On the other hand, as the blocks for construction 10 and 20 have the cavities 13 and 23 opening on the upper and lower surfaces, respectively, when arranging the blocks for construction 10 and 20 to form the panels for construction 40 and 50, these cavities 13 and 23 communicate with each other in a surface direction. Thus, the weight of the panels for construction 40 and 50 can be decreased while providing good heat insulation.

[0057]

In the panels for construction 40 and 50, the reacting force members 32 are attached to the outer peripheral surface of the blocks for construction 10 and 20 located on the peripheral portions of the panels to generate tensile force on the stretching members 30 and 31. Therefore, it is possible to generate appropriate tensile force on the stretching members 30 and 31 to provide excellent strength and durability. Moreover, as the reaction force members 32 are attached so as to cover whole peripheral portions like a frame, the rigidity is increased while the reaction force of the tensile force generated on the stretching members 30 and 31 can be dispersed over the whole peripheral portions. Consequently, generation of cracks caused by stress concentration can be prevented.

[0058]

The length/width ratios and the dimensions of the panels for construction 40 and 50 can be optionally set by changing the number of the blocks for constructions 10 and 20 to be

arranged lengthwise and crosswise or the total number of the blocks, enabling a wide use as various kinds of flat structures constructing a building. Additionally, as shown in Fig. 10, panels for construction 41 and 42 having different shapes (lengthwise/crosswise ratios) or dimensions formed by the plurality of blocks for construction 10 can be combined to form a flat structure such as a fence 43.

[0059]

Next, in reference to Figs. 11 to 20, a block for construction and a panel for construction using the block according to third and fourth embodiments of the present invention are explained.

[0060]

As shown in Figs. 11 and 12, a block for construction 70 of the first embodiment is a block capable of constructing a flat structure (a panel for construction) described below by arranging the plurality of blocks in a flat state with four outer peripheral surfaces thereof, that are, an upper surface 70a, a lower surface 70b, a left side surface 70c and a right side surface 70d brought into contact with each other. In the block for construction 70, a plurality of through holes 71 for inserting bar-like stretching members therein, as further described below, are formed in parallel with a front surface 70f and a rear surface 70e, and recessed parts 72 are formed on the upper surface 70a forming an outer peripheral surface crossing an axial direction of the through holes 71 to dispose, in a direction three-dimensionally crossing the stretching members inserted into the through holes 71, other stretching members.

[0061]

The block for construction 70 is further formed with five cavities 73 opening on the upper surface 70a and the lower surface 70b in a manner of penetrating the block for construction 70. On each of the left side surface 70c and the right side surface 70d, a

groove 74 is formed in the same direction of the arranging direction of the cavities 73.

[0062]

A block for construction 80 illustrated in Figs. 13 and 14 is used in combination with the block for construction 70 and is a block capable of constructing a flat structure by arranging the plurality of blocks 80 in a flat state with three outer peripheral surfaces thereof, that are, an upper surface 80a, a lower surface 80b and a left side surface 80c brought into contact with the block for construction 70. In the block for construction 80, a plurality of through holes 81 for inserting stretching members therein are formed in parallel with a front surface 80f and a rear surface 80e, and recessed parts 82 are formed on the upper surface 80a forming an outer peripheral surface crossing an axial direction of the through holes 81 to dispose, in a direction three-dimensionally crossing the stretching members inserted into the through holes 81, other stretching members.

[0063]

The block for construction 80 is further formed with a plurality of cavities 83 opening on the upper surface 80a and the lower surface 80b in a manner of penetrating the block for construction 80. On the left side surface 80c that is one side surface of the block for construction 80, a groove 84 is formed in the same direction of the arranging direction of the cavities 83.

[0064]

In the block for construction 70 and the block for construction 80, dimensions 70w and 80w in length directions are the same, and the numbers and positions of the through holes 73 and 83 are the same. However, the numbers of the cavities 73 and 83 and the grooves 74 and 84 are different. Specifically, in the block for construction 70, the five cavities 73 are symmetrically disposed and the groove 74 is formed on both of the left side surface 70c and the right side surface 70d whereas, in the block for construction 80, the

three cavities 83 are disposed between a center and the left side surface 80c and the groove 84 is formed only on the left side surface 80c.

[0065]

An auxiliary block 90 illustrated in Figs. 15 and 16 is to be combined with the blocks for construction 70 and 80 to form a panel for construction explained later. The auxiliary block 90 has the same outer dimension as those of the blocks for construction 70 and 80 shown in Fig. 11, and is a block body having a rectangular parallelepiped shape with flat outer peripheral surfaces, provided with a plurality of through holes 91 having the same sizes on the positions corresponding to the positions where the plurality of through holes 71 and 81 are provided on the blocks for construction 70 and 80.

[0066]

As shown in Fig. 17, the plurality of block for construction 70 are arranged in a flat state with the outer peripheral surfaces thereof brought into contact with each other and with the plurality of through holes 71 linearly communicating with each other in an axial direction. Then, as shown in Fig. 20 (a), the stretching members 30 are inserted into the plurality of through holes 11 communicating with each other and, as shown in Fig. 20 (b), the stretching members 31 are disposed in a recessed part 82. In this case, on both distal ends of the stretching members 30, the auxiliary block 90 shown in Fig. 15 is disposed and, on the positions near the both distal ends of the stretching members 31, an auxiliary block 90h (see Fig. 18) is disposed. The auxiliary block 90h has a dimension in a length direction 90w which is a half those of the block for construction 80 and the auxiliary block 90 shown in Fig. 13 and has a recessed part 93. As shown in Fig. 20 (b), the block for construction 80 is arranged with the groove 84 facing toward a center of the stretching member 30 in an axial direction, exposing the right side surface 80d where the groove 84 is not formed.

[0067]

When arranging the blocks for construction 70 and 80 and the auxiliary block 90, as shown in Fig. 19 (a), a cement paste SP which is a gap filling agent for dispersing stress is provided to intervene between the adjacent blocks. The cement paste SP is a curable paste material. The one used in the present embodiment is formed by mixing early-strength portland cement and water in the ratio of around 2.6:1.0. In Fig. 19 (a), the cement paste SP is emphatically illustrated like a conventional "joint"; however, the actual thickness of the cement paste SP is not more than 1mm and, preferably, about 0.1 to 0.2mm.

[0068]

Then, as shown in Fig. 20 (a), holding plates 34d are mounted on the external thread parts 30a of the stretching members 30, which are protruding from the through holes 91 of the blocks for structure 90 located on the outer periphery, followed by mounting spring washers (not shown) and screwing the nuts 37. In addition, as shown in Fig. 20 (b), holding plates 34e are mounted on the external thread parts 31a of the stretching members 31, which are protruding from the recessed parts 82 of the blocks for structure 80 located on the outer periphery, followed by mounting spring washers (not shown) and screwing the nuts 37.

[0069]

At the time when the cement paste SP is cured to be hard enough to transmit compressive stress, each of the nuts 37 is tightened to generate tensile force on the stretching members 30 and 31. Thus, as shown in Fig. 19 (b), gaps between the blocks are filled with the cement paste SP, and the block for structure 70 and 80 and the auxiliary block 90 are firmly bonded to each other with pressure, thereby forming a panel for construction 100 as a flat structure as shown in Fig. 17. In this case, on outer peripheral portions of the panel for construction 100, disposed are the blocks for structure 80 and the auxiliary blocks

90 and 90h which have no uneven surfaces, cavities and through holes except for bolt-holes on their exposed portions. Therefore, the blocks can be firmly bonded to each other with pressure and are free from damages caused by the stress loaded by the stretching members 30 and 31 via the holding plates 34d and 34e.

[0070]

As the stretching members 30 and 31, if deformed reinforcing bars provided with external threads on outer peripheries thereof are employed, the nuts 35 can be screwed on without forming the external thread portions 30a and 31a. In addition, if the stretching members 30 and 31 are coated with a corrosion-resistant material such as a resin pipe, the corrosion resistance is enhanced to prevent rust development due to moisture infiltrating from boundaries between the blocks. Furthermore, the spring washers (not shown) intervening between the holding plates 34d and 34e and the nuts 37 can prevent deterioration of the tensile force caused by contraction of the block or extension of the stretching members 30 and 31.

[0071]

In the panel for construction 100, the blocks 90, 90h and 80, as the reaction members for generating tensile force on the stretching members 30 and 31, are disposed on peripheral portions of the panel for construction 100. Accordingly, the tensile force can be appropriately generated on the stretching members 30 and 31, which leads to excellent strength and durability. Furthermore, since the blocks 90, 90h and 80 as the reaction force members are disposed so as to cover whole peripheral portions, the reaction force of the tensile force generated on the stretching members 30 and 31 can be dispersed over the whole peripheral portions. Consequently, generation of cracks due to stress concentration can be prevented.

[0072]

As shown in Fig. 19 (b), in the panel for construction 100, the cement paste SP which is a gap filling agent for dispersing reacting force intervenes between the adjacent blocks for construction 70 and 80 and the auxiliary blocks 90 and 90h so that gaps between the adjacent blocks are filled with the cement paste SP. By this structure, compressive stress generated between the blocks is uniformly dispersed and transmitted through the adjacent blocks. Therefore, generation of cracks or ruptures on the blocks for construction 70 and 80 and the auxiliary blocks 90 and 90h due to the concentration of compressive stress can be prevented.

[0073]

In the above structure, the cement paste SP is employed as a gap filling agent. As a result, in the panel for construction 100, most of the small gaps between the adjacent blocks for construction 70 and 80 and the auxiliary blocks 90 and 90h can be eliminated, and the compressive stress is uniformly dispersed and transmitted, thereby preventing generation of cracks or ruptures due to stress concentration. Other gap filling agents for dispersing stress than the cement paste SP may be a paper material, liquid glass, or a metallic material which is deformable by the pressure of the bonded blocks exerted by tensile force generated on the stretching members 30 and 31 (a ferrous material such as a steel sheet, for example).

[0074]

Meanwhile, the block for construction 80 and the auxiliary blocks 90 and 90h which are block bodies having a solid structure are used in regions close to the peripheral portions of the panel for construction 100. Therefore, the force loaded on these blocks 80, 90 and 90h as the reaction force members to generate tensile force on the stretching members 30 and 31 does not break or damage the blocks 80, 90 and 90h. Moreover, with the presence of the stretching members 30 and 31, the panel for construction 100 can be

elastically deformed in a deflective direction.

[0075]

The length/width ratio and the dimension of the panel for construction 100 can be optionally set by changing the number of the blocks for construction 70 and 80 and the auxiliary blocks 90 and 90h to be arranged lengthwise and crosswise or the total number of the blocks. Accordingly, the panel for construction 100 can be widely used as a various kinds of flat structures constructing a building.

[0076]

The block for construction and the panel for construction according to the present invention can be widely used as materials for forming a flat structure such as a wall, a floor, a ceiling or a fence of a building.